observation is correct, however, this structure does not anticipate claim 1 and hence the claims dependent therefrom.

The following is a copy of claim 1 with reference numerals to Applicant's specification and drawings which show the relationships claimed in claim 1.

1. A vapor phase growth apparatus allowing vapor phase growth of a silicon single crystal film on a main surface of a silicon single crystal substrate to proceed therein,

having a reaction vessel having a gas introducing port formed on a first end side in the horizontal direction, and having a gas discharging port on a second end side in the same direction, configured as allowing a source gas for forming the silicon single crystal film to be introduced through the gas introducing port into the reaction vessel, and to flow along the main surface of the silicon single crystal substrate held in a near-horizontally rotating manner in the inner space of the reaction vessel, and to be discharged through the gas discharging port, the silicon single crystal substrate being disposed on a disc-formed susceptor rotated in the inner space, and having a bank **23** component disposed so as to surround the susceptor, and kept in a positional relation so as to align the top surface thereof at an almost same level with the top surface of the susceptor, and

further configured so that the gas introducing port is opened so as to oppose to the outer peripheral surface of the bank **23** component, so as to allow the source gas supplied through the gas introducing port to collide against the outer peripheral surface of the bank component and to climb up onto the top surface side thereof, and then to flow along the main surface of the silicon single crystal substrate on the susceptor,

further comprising an upper lining component disposed so as to hang over the bank component, while forming a gas introducing gap **60** communicated with the reaction vessel by the bank component and the upper lining component;

wherein, assuming a virtual **HSL** center line along the direction of flow of the source gas, extending from the first end of the reaction vessel

towards the second end, while crossing normal to the axis of rotation **O** of the susceptor, as the horizontal standard line **HSL**, and also assuming the direction normal to both of the axis of rotation of the susceptor and the horizontal standard line as the width-wise **WL** direction,

the gas introducing gap **60** is configured so that the length-to-be-formed thereof in the parallel direction with the horizontal standard line **HSL** is shortened in a continuous $\mathbf{D_1 < D_0}$ or step-wise manner as distanced from the horizontal standard line **HSL** in the width-wise **WL (Fig. 7)** direction, or remained constant $\mathbf{D_0}$ **(Fig. 9)** at any position.

In the above references to Applicant's specification, it is clearly seen that claim 1 defines a unique relationship between the three axis claimed. These axis are the rotation axis of the susceptor, the horizontal standard line (HSL) and the width-wise direction. Attachment 1 shows these three axis as set forth in the claim. These three axis, while found in standard susceptors, show that the '939 structure does not anticipate the last clause of Applicant's claim 1. The Examiner has relied upon the guide plates as a rectification.

However, the guide plates of '939 do not respond to the last paragraph where Applicant recited that the introducing gap is configured so that the length to be formed thereof in the parallel direction with the horizontal standard line is shortened in a continuous or step-wise manner as distanced from the horizontal standard line (HSL). This is demonstrated in Applicant's Fig. 7 by the fact that D_1 is less than D_0. This relationship is then defined as distance from the horizontal standard line (HSL) in width-wise direction, as shown in Fig. 7 or remaining constant as shown in Fig. 9. These configurations are achieved by maintaining a relationship between R_1 and R_3 (Fig. 7) where R_1 is less than R_3. The introducing gap is shown as 60 (shaded area) Figs. 7 and 9. In '939 the introducing gap is refined by conventional concentric circles from the axis of rotation. Applicant claims structures which are not concentric circles.

'939 has an introducing gap in the region of 3a, identified as gas supply openings. These gas supply openings, however, do not respond to the limitations of claim 1 because they are constructed in the manner of the prior art, namely that there is no shortening in the continuous step-wise manner in the width-wise direction or remaining constant in any position. The difference is best illustrated in '939 in the fact that it is not the introducing gap which is varied, but instead, the area at the exhaust of the turning veins or control veins 10. These areas are identified as 11a - 11f. The areas produced in 11a - 11f provide for different rates of flow to the rotating wafer which provide for a more even flow as illustrated in comparing Fig. 4A (prior art of Fig. 4) and 4B the '939 invention with the controlled outlets 11a - 11f. The guide plates, as interpreted by the Examiner (11a - 11f), rectify each reactive gas guided into the process chamber and provide for the guidance. In contrast, Applicant provides control and introduction of gas into the reaction area by the introducing gap, not guide plates which are located down stream from the introducing gap. In Applicant's invention, it is the configuration of the gap which controls flow and not guide plates. In '939 the introducing gap is any of 3a to 3c, but in any case the gap is only prior art concentric circles and not as set forth in the last paragraph of claim 1.

'939 at [0013] describes the gas supplying ports 3a - 3e and at [0016] describes the structure and function of the guide plates 11a - 11f. See English-language translation of Japanese specification attached.

For the foregoing reasons, the rejection of claim 1 and it's dependent claims as being anticipated by '939 is respectfully traversed.

I. Double-Patenting

Applicant respectfully traverses the rejection of claim 1 on the ground of non-statutory obviousness-type double-patenting over claim 1 of co-pending Application No. 10/582,860. '860, like '939, utilizes guide plates to control the flow of gas to the rotating wafer. The

claims of '860 are directed to this guide plate feature of the art, and require a guide component dividing the flow of the gas in the width-wise direction disposed on a top surface of the bank component (claim 1). This is entirely different from Applicant's claim structure of claim 1 in this application as explained above with respect to the rejection under 35 U.S.C. §102.

II. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

Ronald R. Snider
Registration No. 24,962

RRS/axl

Attachments:
English-Language Translation of JP 2000-331939
Attachment 1 (Axis of Rotation Graph)

Date: December 17, 2008

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PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2000-331939
(43)Date of publication of application : 30.11.2000

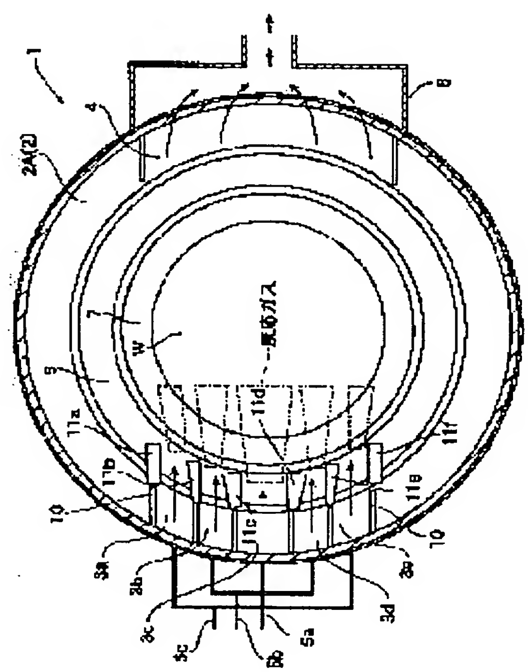
(51)Int.Cl. H01L 21/205
C23C 16/44

(21)Application number : 11-136067
(22)Date of filing : 17.05.1999

(71)Applicant : APPLIED MATERIALS INC
(72)Inventor : TAKAGI YOJI
ARIMA YASUJI

(54) FILM-FORMING DEVICE

(57)Abstract:



PROBLEM TO BE SOLVED: To improve evenness in the film-thickness distribution of a thin film formed on a wafer surface, related to a semiconductor manufacturing device.

SOLUTION: An epitaxial growth device 1 comprises a process chamber 2, and a liner part 2A which forms a part of the side part of the process chamber 2 is provided with gas support openings 3a to 3e and gas exhaust opening 4 which each other. A susceptor 7 for supporting wafer W is provided in the process chamber 2, and a pre-heating ring 9 is provided between the liner part 2A and the susceptor 7. At the upper part of the pre-heating ring 9, guide plates 11a-11f extending on a placement part 7a side of the susceptor 7 from the tip of a plurality of side walls 10 which form the gas supply openings 3a to 3e are provided side by side in horizontal direction. The guide plates 11a to 11f rectify each reactive gas guided into the process chamber 2 and guide it to a specified region on the surface of wafer W placed on the placement part 7A.

CLAIMS

[Claim(s)]

[Claim 1]A film deposition system which introduces reactant gas in a processing chamber, passes along the surface of a processed object, is a film deposition system which forms membranes by carrying out a thermal decomposition reaction, and is provided with a guide means for leading said reactant gas introduced in said processing chamber to the surface of said processed object.

[Claim 2]A film deposition system comprising:
A processing chamber which has a gas supplying port.
It is installed in said processing chamber and has a wafer support member which has a placing part on which a processed object is put, Introduce reactant gas in said processing chamber from said gas supplying port, and it passes along the surface of said processed object, A guide member for leading said reactant gas which is a film deposition system which forms membranes by carrying out a thermal decomposition reaction, was prolonged toward said placing part from said gas supplying port, and was introduced in said processing chamber to the surface of said processed object.

[Claim 3]The film deposition system according to claim 2 with which a heating component for heating said reactant gas introduced from said gas supplying port is provided in the outside of said wafer support member in said processing chamber, and said guide member is provided in the upper part of said heating component.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention]This invention relates to film deposition systems which form membranes by passing and carrying out the thermal decomposition reaction of the reactant gas along the surface of a processed object, such as an epitaxial growth system.
[0002]
[Description of the Prior Art]The epitaxial growth system of single wafer processing in the former, For example, it comprised silica glass, and it was allocated in the processing chamber which has a gas supplying port and a gas exhaust port, and this processing chamber, and has a susceptor which supports a semiconductor wafer, and two or more halogen lamps arranged the upper part of a processing chamber, and caudad radiately. In such an epitaxial growth system, after laying a wafer on a susceptor, turn on a halogen lamp, heat a wafer, and. If reactant gas is introduced in a processing chamber from a gas supplying port, reactant gas will flow in the state of laminar flow along the surface of the wafer heated by prescribed temperature, the thermal decomposition reaction of reactant gas will occur, and a thin film will be formed in a wafer surface.
[0003]By the way, it is in the tendency for the thickness distribution of the thin film formed in a wafer surface of factors, such as an installed position of a halogen lamp and the rate of flow of reactant gas, to become uneven, in such membrane formation processing. Then, two or more gas supplying ports are established in a processing chamber, and he adjusts the flow rate of the reactant gas introduced in a processing chamber from each gas supplying port, and is trying to improve in the former the thickness distribution of the thin film formed in a wafer surface.
[0004]
[Problem(s) to be Solved by the Invention]However, as mentioned above, the flow of reactant gas was divided into two or more zones, and there was a limit in improving the thickness uniformity of the thin film on a wafer only by controlling the flow rate of the reactant gas in each zone.

[0005]The purpose of this invention is to provide the film deposition system which can raise the homogeneity of the thickness distribution of the thin film formed in a wafer surface.
[0006]
[Means for Solving the Problem]In order to attain the above-mentioned purpose, this invention introduces reactant gas in a processing chamber, and passes it along the surface of a processed object, it is a film deposition system which forms membranes by carrying out a thermal decomposition reaction, and a film deposition system provided with a guide means for leading reactant gas introduced in a processing chamber to the surface of a processed object is provided.
[0007]By thus, a thing adjusted so that reactant gas may flow toward a field in a tendency which runs short of thickness of a thin film in a wafer surface, since it becomes possible to control a direction into which reactant gas flows by providing a guide member. The thickness uniformity of a thin film formed in a wafer surface can be raised.
[0008]A film deposition system this invention is characterized by that comprises the following in order to attain the above-mentioned purpose.
A processing chamber which has a gas supplying port.
It is installed in a processing chamber and has a wafer support member which has a placing part on which a processed object is put, A guide member for leading reactant gas which introduced reactant gas in a processing chamber from a gas supplying port, is a film deposition system which passes along the surface of a processed object and forms membranes by carrying out a thermal decomposition reaction, was prolonged toward a placing part from a gas supplying port, and was introduced in a processing chamber to the surface of a processed object.

[0009]In thus, a position near a field (henceforth a reaction region) to which a thermal decomposition reaction is performed by providing a guide member. Since it becomes possible to control a direction into which reactant gas flows, the homogeneity of thickness distribution of a thin film formed in a wafer surface can be raised by adjusting a flow of reactant gas precisely. In order to spread reactant gas from a position near a reaction region, when it has two or more gas supplying ports in a processing chamber, specifically, the reactant gas introduced from each gas supplying port comes to carry out the abouchement in a position which is distant from a reaction region. For this reason, it becomes easy to control a flow of reactant gas, and thickness uniformity of a thin film on a wafer can be made good by adjusting so that reactant gas may flow toward a field in a tendency which runs short of thickness of a thin film in a wafer surface.
[0010]In the above-mentioned semiconductor manufacturing device, a heating component for heating reactant gas introduced from a gas supplying port is provided in the outside of a wafer support member in a processing chamber, and a guide member is provided in the upper part of a heating component.
[0011]

[Embodiment of the Invention]Hereafter, the suitable embodiment of this invention is described with reference to drawings.

[0012]Drawing 1 shows roughly the epitaxial growth system of single wafer processing which carries out membrane formation processing of every one silicon wafer which is a processed object as a film deposition system concerning this invention, and drawing 2 is a flat-surface sectional view of the epitaxial growth system. In the figure, the epitaxial growth system 1 is provided with the processing chamber 2 which comprised silica glass, and the gas supplying ports 3a-3e and the gas exhaust port 4 of plurality (here five) counter the liner part 2A which forms a part of flank of this processing chamber 2, and it is formed in it.

[0013]The gas supplying pipelines 5a are connected to the gas supplying port 3c located in the center among the gas supplying ports 3a-3e, The gas supplying pipelines 5b are connected to the gas supplying ports 3b and 3d located in the horizontal outside of the gas supplying port 3c, The gas supplying pipelines 5c are connected to the gas supplying ports 3a and 3e located in the each gas supplying ports [3b and 3d] horizontal outside, and the flow of the reactant gas introduced in the processing chamber 2 is divided into three zones. The flueing duct 6 is connected to the gas exhaust port 4.

[0014]In the processing chamber 2, the susceptor 7 which is a wafer support member for supporting the wafer W is allocated. This susceptor 7 comprises the graphite material covered with carbonization silicon, and the disc-like concave placing part 7a by which the wafer W is put on an upper face part is formed. The susceptor 7 is horizontally supported by three points from the rear-face side by the supporting shaft 8 made from silica glass set up by the lower part of the processing chamber 2, rotates this supporting shaft 8 with the drive motor which is not illustrated, and, thereby, can rotate the susceptor 7 now.

[0015]Between the liner part 2A and the susceptor 7, the preheating ring 9 for heating the reactant gas supplied to each gas supplying ports 3a-3e is formed, and it enables it to perform an effective thermal decomposition reaction to the wafer W supported by the placing part 7a.

[0016]The six guide plates 11a-11f prolonged in the placing part 7a side of the susceptor 7 from the tip of two or more side attachment walls 10 which form the gas supplying ports 3a-3e are horizontally installed in the upper part of such a preheating ring 9 side by side. These guide plates 11a-11f rectify the reactant gas introduced in the processing chamber 2 from each gas supplying ports 3a-3e, and lead it to the predetermined region of the wafer W surface put on the placing part 7a. The guide plates 11a and 11f located in the outermost part among the guide plates 11a-11f are arranged almost straightly to the side attachment wall 10 which is making approximately rectangular parallelepiped shape and corresponds. The horizontal section is making tapered shape, and the guide plates 11b-11e are in the state slightly leaned outside to the corresponding side attachment wall 10, and they are arranged so that it may become point ** to the susceptor 7 side. Thereby, the horizontal interval between adjoining guide plates is becoming narrow gradually toward the susceptor 7 side.

[0017]Two or more halogen lamps (an infrared lamp or a far-infrared lamp) 12 for heating the wafer W placed by the upper part of the processing chamber 2 and the lower part on the placing part 7a of the susceptor 7 to an elevated temperature are arranged at the radial, respectively.

[0018]In the epitaxial growth system 1 constituted as mentioned above, after laying the wafer W in the placing part 7a of the susceptor 7, raise the power of the halogen lamp 12, heat the wafer W to treatment temperature, and. Where the susceptor 7 is rotated, reactant gas, such as trichlorosilan (SiHCl3) gas and dichloro silane (SiH2Cl2) gas, is supplied in the processing chamber 2 from each gas supplying ports 3a-3e by the gas supplying pipelines 5a-5c. Then, the reactant gas heated in the preheating ring 9 flows in the state of laminar flow along the surface of the wafer W heated by prescribed temperature, on the wafer W, the single crystal of silicon grows epitaxially and a thin film is formed.

[0019]Here, an example of the conventional epitaxial growth system is shown in drawing 3 as a comparative example. In the figure, the above-mentioned guide plate 11a - 11fc are not provided in the conventional epitaxial growth system 100. The composition of others of the epitaxial growth system 100 is the same as the epitaxial growth system 1 mentioned above.

[0020]In such a conventional epitaxial growth system 100. By factors, such as an installed position of the halogen lamp 12, and the rate of flow of reactant gas, the flow rate of the reactant gas introduced in the processing chamber 2 from each gas supplying ports 3a-3e is adjusted that the thickness distribution of the thin film which tends to become uneven should be improved, and membrane formation processing of a wafer is performed. For example, as shown in drawing 4 (a), the thickness distribution of the thin film formed in a wafer surface, In being in the tendency which becomes an overthin film in the inner area A and the outside area B of a wafer, and becomes the shortage of a thin film by the staging area C between the inner area A and the outside area B, He controls formation of the thin film in the inner area A and the outside area B, and is trying to promote formation of the thin film in the staging area C by making it larger than the flow of the reactant gas to which the flow of the reactant gas supplied to the gas supplying ports 3b and 3d is supplied by the gas supplying ports 3a, 3c, and 3e. Drawing 4 (a) shows the thickness distribution of the thin film M formed in a wafer surface when a wafer is cut to a diametral direction.

[0021]However, since each reactant gas which blew off from the gas supplying pipelines 5a-5c to the gas supplying ports 3a-3e is spread from the portion of the gas supplying ports 3a-3e in this case, As shown in the dotted line of drawing 3, the reactant gas from an adjoining gas outlet will carry out the abouchement mutually in the field (henceforth a reaction region) in which a thermal decomposition reaction is actually performed. For this reason, it is difficult to improve the thickness distribution of the thin film M as formation of a thin film most promoted in the abouchement region of the reactant gas in the wafer W and shown in drawing 4 (a).

[0022]On the other hand, since the guide plates 11a-11e prolonged in the susceptor 7 side

from the tip of the side attachment wall 10 were formed in the upper part of the preheating ring 9 in this embodiment, Each reactant gas which blew off from the gas supplying pipelines 5a-5c to the gas supplying ports 3a-3e is spread from the portion of the guide plates 11a-11e, i.e., a comparative example, from the position of the flow direction downstream of reactant gas, as the dotted line of drawing 2 shows. Therefore, as the dotted line of drawing 2 shows, it comes to carry out the abouchement of the reactant gas mutually in the position which is distant from a reaction region. For this reason, in having the thickness distribution of the thin film M as shown in drawing 4 (a). Formation of the thin film in the inner area A and the outside area B of the wafer W is certainly controlled by making it larger than the flow of the reactant gas to which the flow of the reactant gas supplied to the gas supplying ports 3b and 3d as mentioned above is supplied by the gas supplying ports 3a, 3c, and 3e. As a result, the thickness distribution of the thin film M becomes almost uniform as shown in drawing 4 (b). As an example, the thickness error of the thin film was able to be suppressed to 1% or less.

[0023]As mentioned above, although the suitable embodiment of this invention was described, it cannot be overemphasized that this invention is not limited to the above-mentioned embodiment. For example, the guide plates 11a-11e were constituted from an above-mentioned embodiment so that it might extend to the preheating ring 9, but it may constitute so that it may extend to this side position of the placing part 7a in the susceptor 7. The interval may be constant although the interval between adjoining guide plates was made to become narrow to the susceptor 7 side. What is necessary is just to set up suitably the shape of such a guide plate, a size, a fixing attitude, an installed number, etc. according to the thickness distribution characteristic of the thin film formed in the wafer W surface.

[0024]Although the film deposition system of the above-mentioned embodiment is an epitaxial growth system which has a preheating ring, this invention is applicable also to the epitaxial growth system with which the preheating ring is not provided. This invention is applicable to film deposition systems other than an epitaxial growth system, for example, a CVD system etc.

[0025]

[Effect of the Invention]According to this invention, the guide member for leading the reactant gas introduced in the processing chamber to the surface of a processed object is provided, and since it enabled it to control not only the flow of reactant gas but the direction into which reactant gas flows, the homogeneity of the thickness distribution of the thin film formed in a wafer surface improves.

[Translation done.]

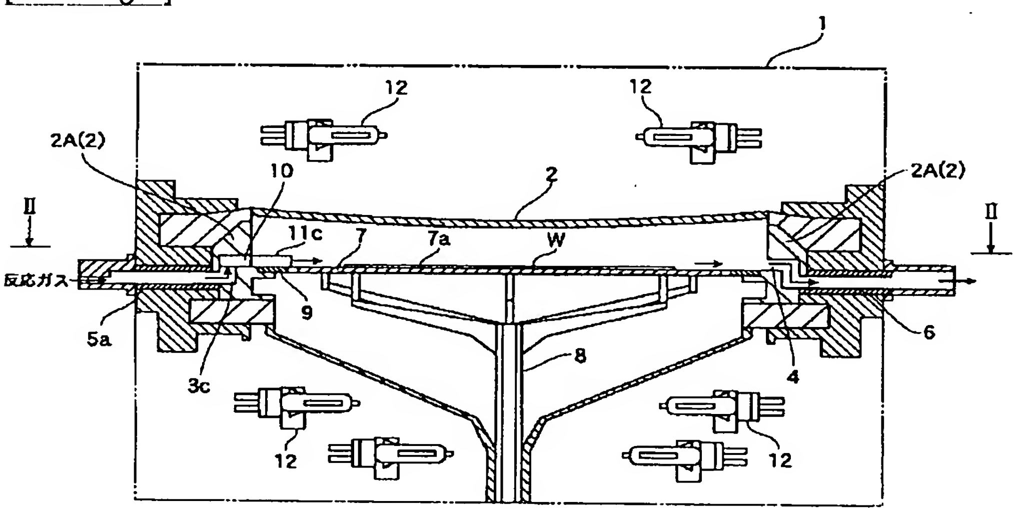
DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is an explanatory view showing roughly the epitaxial growth system which is a film deposition system concerning this invention.
[Drawing 2]It is an II-II line sectional view of drawing 1.
[Drawing 3]It is a flat-surface sectional view showing an example of the epitaxial growth system in the former.
[Drawing 4](a) is a figure showing an example of the thickness distribution of the thin film formed in a wafer surface, and (b) is a figure showing thickness distribution when a thin film is formed in a wafer using the epitaxial growth system shown in drawing 1.
[Description of Notations]
1 [-- A susceptor (wafer support member) 7a / -- A placing part, 9 / -- A preheating ring (heating component), 10 / -- A side attachment wall, 11a-11f / -- A guide plate (guide member), W / -- Wafer (processed object).] -- An epitaxial growth system (film deposition system), 2 -- A processing chamber, 3a-3e -- A gas supplying port, 7

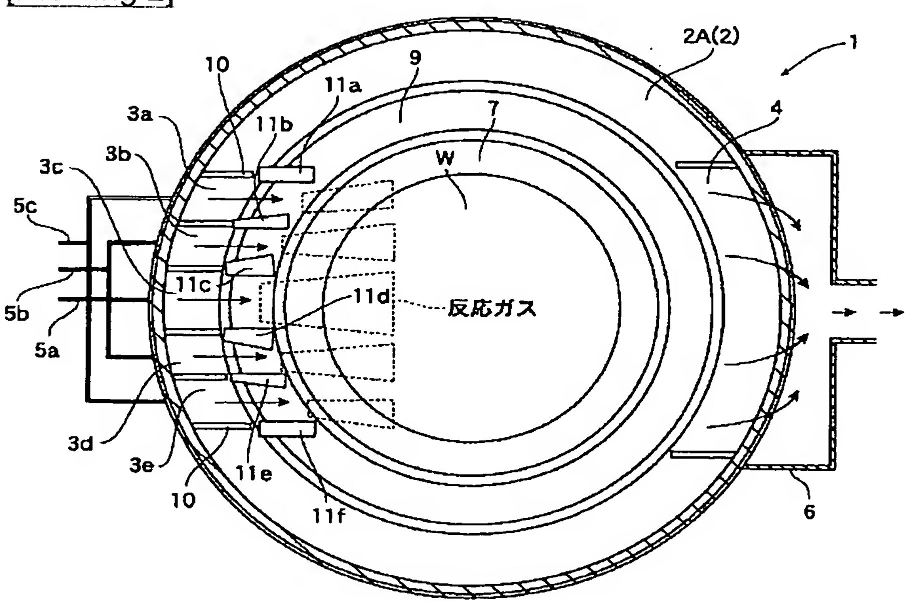
[Translation done.]

DRAWINGS

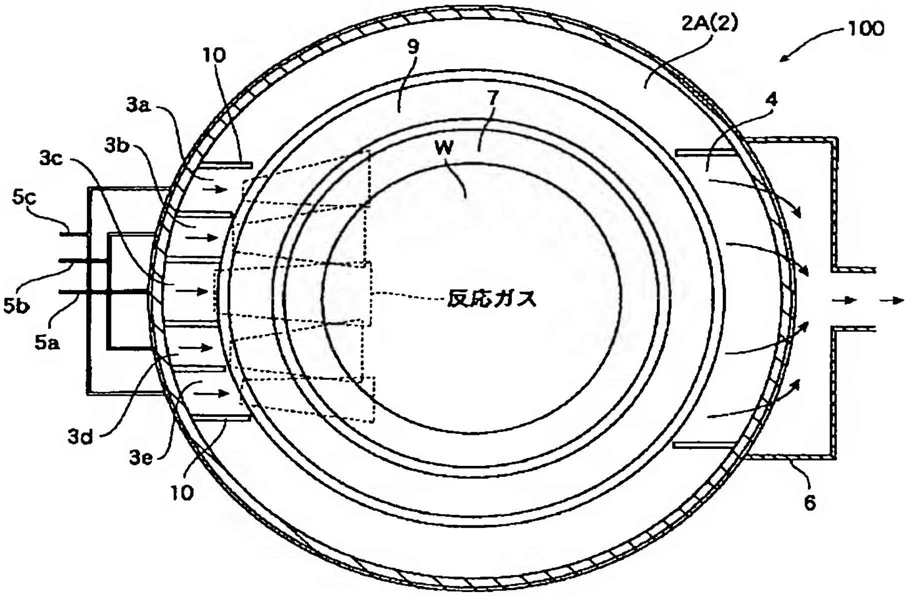
[Drawing 1]



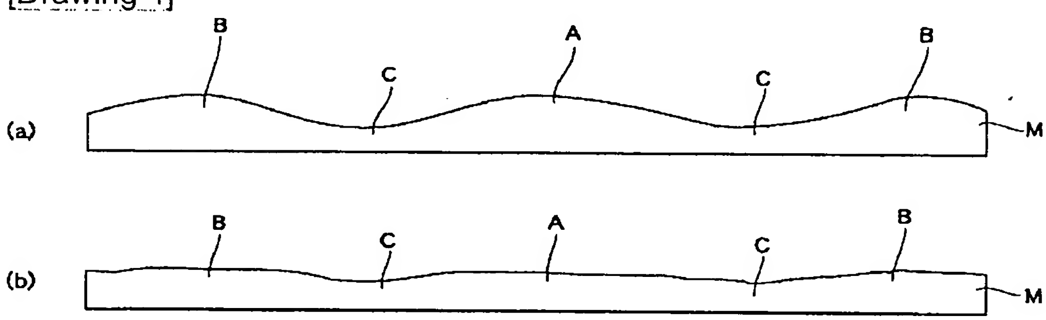
[Drawing 2]



[Drawing 3]



[Drawing 4]



[Translation done.]

ATTACHMENT 1